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$$\begin{aligned}
 2. \quad AB^2 &= 2ADP + BPDY = AE.DP + EF.DP \\
 &= AF.DP = AF(DE + EP) = AF(AF + EP) \\
 &= AF^2 + AF.EP = AF^2 + AF.FR = AF^2 + BF^2.
 \end{aligned}$$

In Todhunter's Spher. Trig., p. 109, Ex. 16, it is stated that, "If O be any point within any spherical triangle ABC , the product of the sines of any two sides and the sine of the included angle is

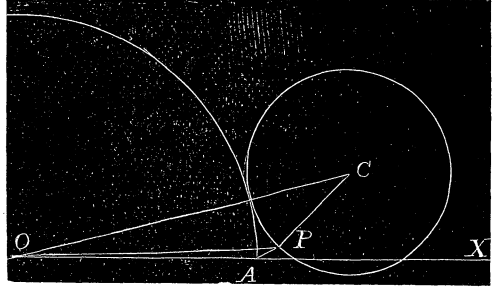
$$\sin AO \sin BO \sin CO (\cot AO \sin BOC + \cot BO \sin COA + \cot CO \sin AOB)."$$

How is this demonstrated?

ANSWER TO QUERY AT P. 16, BY PROF. C. M. WOODWARD, WASHINGTON UNIV., ST. LOUIS, MO.—Let the origin of coordinates be the centre of the largest wheel, and let the axis of X pass through the point where the face of a tooth meets the pitch circle.

Let P be the tracing point, and C the centre of the rolling circle.

The equations of the face of the tooth are



$$x = (R+r) \cos \theta - r \cos \left(\frac{R+r}{r} \right) \theta, \quad y = (R+r) \sin \theta - r \sin \left(\frac{R+r}{r} \right) \theta,$$

in which θ is the angle between the line of centres and the axis of X .

If we designate by β the angle between the radius vector to the tracing point and the axis of X , the triangle $OC P$ readily gives

$$\frac{\sin(\theta - \beta)}{\sin[\theta(R+r) \div r - \beta]} = \frac{r}{R+r},$$

which gives the relation between θ and β .

It is obvious that the addendum required is given by the expression

$$\sqrt{x^2 + y^2} - R.$$

In the given example, $R = 0.39$ in., $r = 0.0325$ in., $(R+r) \div r = 13$.

The equation of relation is

$$\frac{\sin(\theta - 1^\circ.5)}{\sin(13\theta - 1^\circ.5)} = \frac{1}{13},$$

which gives, by approximation, $\theta = 5^\circ 42' 48''$.

Making the substitutions, I get

$$\sqrt{x^2 + y^2} - R = 0.0218 \text{ in., the addendum.}$$